1Ph_FW_Inverter_RLC_Load -- Overview

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1-PHASE FULL-WAVE INVERTER WITH R-L-C LOAD

Objective:

After performing this lab exercise, learner will be able to:

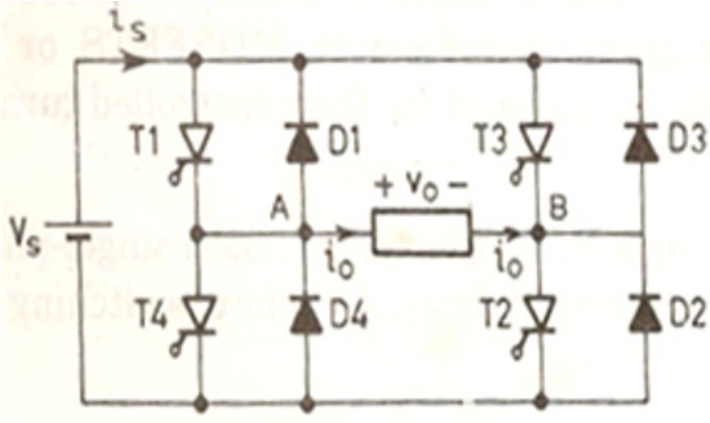
- Understand the working of DC-AC inverter
- Learn the role of Power Electronics in utility related applications.
- Understand and design single-phase Full Wave Inverter.
- Understand the concept of underdamping and over-damping
- Analyze and interpret results
- Work with digital oscilloscope to debug circuit and analyze signals

Equipment:

To carry out this experiment, you will need:

- Single phase inverter kit
- SCR firing circuit kit, 1-phase, 230V, 5A
- Patch chords
- Load
- Digital Oscilloscope

Circuit Diagram:

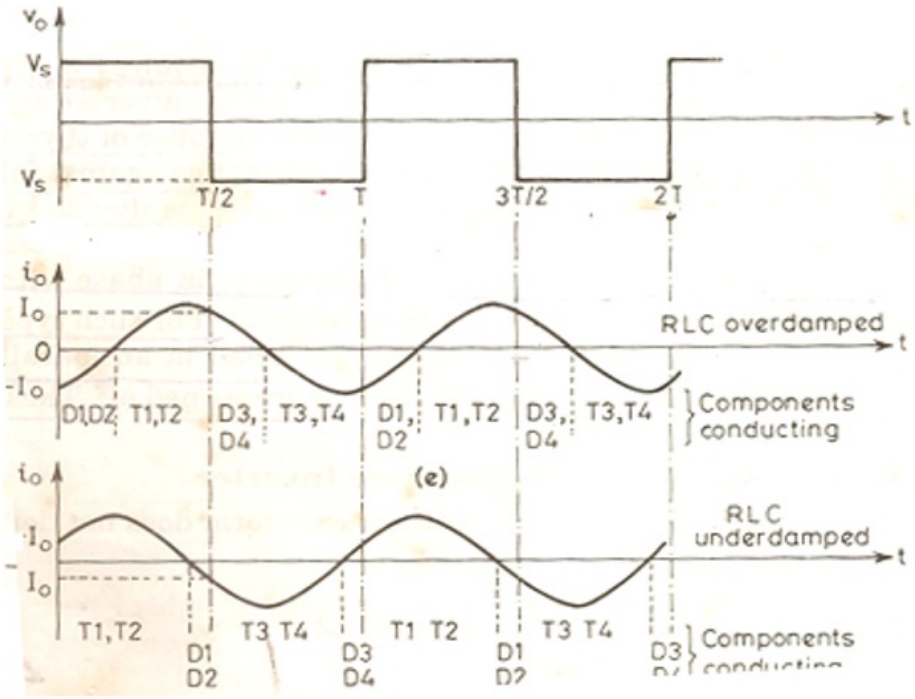


Theory:

- Single phase full bridge inverter consists of four SCRs and four diodes. For Full bridge inverter when T1, T2 conduct, load voltage is Vs and T3, T4 conduct load voltage is –Vs.

- Frequency of output voltage can be controlled by varying the periodic time T.
- During inverter operation it should be ensured that two thyristors in the same branch should not conduct simultaneously as this would lead to a direct short circuit of the source.
- For inductive load, load voltage and load current will not be in phase with each other. In this case diodes D1, D2, D3 and D4 connected in antiparallel will thyristors will allow the current to flow when main thyristors are turned off. As the energy is fed back to the dc source when these diodes conduct, these are called feedback diodes.
- Operation of series R-L-C load can be explained for R-L-C under damped and over damped load.
- R-L-C Over Damped Load:
  - Before t = 0, thyristors T3 and T4 are conducting and load current i0 is flowing from B to A, i.e. in reverse direction. This current is –I_o at t =0.
  - After T3 and T4 are turned off at t = 0, current i_o cannot change its direction immediately because if the nature of load. As a result diodes D1 and D2 starts conducting after t = 0 and allow i0 to flow against the supply voltage Vs. A soon as D1 and D2 begin to conduct, the load is subjected to Vs.
  - Though T1 and T2 are gated at t = 0, these SCRs will not turn on as these are reverse biased by the voltage drop across the diodes D1 and D2. When Load current through D1 and D2 falls to zero, T1 and T2 becomes forward biased by source voltage Vs.
  - Now T1 and T2 get turned on as these are gated for the period of T/2 seconds. Now load current i_o flows in the positive direction from A to B. At t = T/2; T1 and T2 are turned off by forced commutation and as load current cannot reverse immediately, diodes D3 and D4 come into conduction to allow the flow of current i0 after T/2.
  - Thyristor T3 and T4 though gated will not turn on as these are reverse biased by the voltage drop in diodes D3 and D4. When the current in diodes D3 and D4 drops to zero; T3 and T4 are turned on as these are already gated
- R-L-C Over Damped Load:
  - For R-L-C under damped load after t = 0, thyristor T1 and T2 are carrying load current i_o. As io through T1 and T2 reduces to zero at t1, these SCRs are turned off before T3 and T4 are gated.
  - As T1 and T2 stops conducting, current through the load reverses and now is carried by diodes D1 and D2 as T3 and T4 are not yet gated.
  - The diodes D1 and D2 are connected in antiparallel to T1 and T2; the voltage drop in these diodes appears as a

reverse bias across T1 and T2.
    - If the duration of reverse bias is more than the SCR turn off time; T1 and T2 will get commutated naturally and therefore no commutation circuitry is needed.
    - This method of commutation is known as load commutation.
- The ideal waveform of the experimental setup is shown in Figure below:



1Ph_FW_Inverter_RLC_Load -- Procedures

Step 1

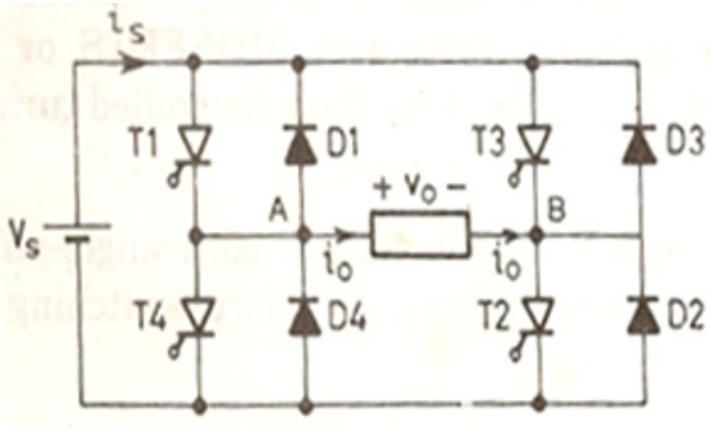
Precautions:

- A main switch should be included in whole circuit, so that in case of any emergency main supply can be disconnected from the circuit.
- Check all the connection before switching ON the power supply.
- Apply low voltages or low power to check the proper functionality of circuits.
- Load should be remained connected to the experimental setup for discharging the energy stored in the inductor or capacitor present in the circuit, if any.
- Don’t touch live wires.

Step 2

Circuit Setup:

Build the circuit as shown below:



Step 3

Probe across load resistance (V_0)

Step 4

Keep the multiplication factor of the CRO’s probe at the maximum position (10X or 100X - whichever is available)

Step 5

Switch on the experimental kit and firing circuit kit.

Step 6

- Set the duty cycle to 50%
- Capture output waveform on oscilloscope

Step 7

- Measure the RMS value of the output
- Take screenshot of output waveform.

Step 8

Switch off the power supply and disconnect from the power source.